

REMARKS

In accordance with the foregoing, claims 1, 12 and 15 have been amended. Claims 1-7 and claims 12-15 are pending and under consideration.

Applicant responds to the Office Action mailed March 29, 2004 as follows:

Claims 1-3 and 12-15 have been rejected under 35 U. S. C. 102(b) as being anticipated by Kaufman et al. Also, claims 1-3, 7 and 12-15 have been under 35 U. S. C. 102(b) as being anticipated by Allen et al. Claims 4-6 and 7 have been rejected under 35 U. S. C 103(a) as being unpatentable over Kaufman et al. in view of Marks. Claims 4-6 have been rejected under 35 U. S. C. 103(a) as being unpatentable over Allen et al. in view Marks.

Independent claim 1 has been amended to better define the subject matter of the present invention. The rejections are respectfully traversed. Reconsideration and withdrawal thereof are respectfully requested.

As is apparent in amended claim 1 and claim 12 and the specification, the present invention is directed to an apparatus for manufacturing ultra-fine particles which is designed to easily and effectively obtain the ultra-fine particles and to control the sizes of the ultra-fine particles using an electro-hydro-dynamic atomization(EHDA) process. Electro-hydro-dynamic atomizers form desired highly charged hyperfine liquid droplets by exposing the droplets to an electric field having a high voltage difference. The hyperfine liquid droplets produced by the electro-hydro-dynamic atomizer have a very small size of about several ten nanometers. In the present invention, a high voltage is applied to a capillary and a low voltage having the same polarity as the high voltage applied the capillary is applied to a guide duct. Accordingly, the highly charged liquid droplets P continue to move along a central axis of the guide duct toward a portion to which a lower voltage is applied without adhering to the wall of the guide duct. Further, the heating means heats the outer surface of the guide duct so as to the evaporate the sprayed liquid droplets and generate chemical reactions thereof.

Addressing the issues presented in the Office Action, firstly, the Examiner points out that Kaufman et al. shows an apparatus for manufacturing ultra-fine particles having a guide duct 164, capillary 176 with insulating jacket 72, carrier gas supplying means 168, voltage supplying means 174, heating means and collecting means 184. However, it is well known that many ultra-fine particle manufacturing apparatus generally comprise a guide duct, one or more capillary, carrier gas supplying means, a voltage source, heating means and collecting means. Thus, it is believed that the present invention cannot be anticipated by Kaufman et al. by means of such common elements without considering the limitations thereof because there are positionally and functionally different relations therebetween.

Kaufman et al. is directed to an apparatus for generating uniform droplets having diameters of less than one micrometer. In Kaufman et al., a high voltage source 174 bias the capillary 176 and to a predetermined level, while surrounding structure is grounded. (column 9, lines 45-47). The voltage applying manner of Kaufman et al. differs from that of the present invention. In Kaufman et al., the gas, typically air filtered by the filter 168 the chamber 162. However, the filtered air does not carry the particles sprayed through the capillary 176 but is used to prevent fragmentation of the droplets(column 9, lines 3 to 24). The heater 170 of Kaufman et al. heats the air (numeral is not given) filtered by the filter (numeral is not given). The air from the heater 170 enters the evaporation chamber, to maintain the temperature within chamber 162 at 32 degrees C, or more, to promote evaporation of droplets of the liquid sample(column 5, lines 40-44). The heater 170 of Kaufman et al does not heat the outer surface of the guide duct 164 and does not give the chamber 164 the energy for generating the chemical reactions like the present invention.

Secondly, the Examiner points out that Allen et al. shows an apparatus having a guide duct, capillary 24, carrier gas supplying means 36, heating means 37, collecting means, 12, 72 and cooling means 74, 22. Like the Kaufman et al., it is believed that the present invention can not be anticipated by Allen et al. by means of the common elements without considering the limitations thereof because there are positionally and functionally different relations therebetween.

Allen et al. is directed to a highly efficient electrospray ionization interface apparatus for mass spectrometry. In Allen et al., the pressured supply 36 does not carry the particles sprayed

through the capillary (needle) 24 but supplies a gas to maintain the chamber 32 at approximately atmospheric pressure(column 6, lines 27-34). Also, the heating means(heat exchanger jacket) 37 maintain the temperature of the electrospray chamber 32 at a desired value. The optimum temperature of the chamber 32 depends on the composition and flow rate of the liquid, as well as on the internal diameter of the electrospray needle, but appropriate temperatures are typically in the range of 40° to 60° C. The heating means 37 of Allen et al. does not give the chamber 32 the energy for generating the chemical reactions like present invention.

Turning to the present invention, the present invention has three different features in comparison with Kaufman et al. or Allen et al.. First, the present invention comprises a carrier gas supplying means for supplying carrier gas into the guide duct to quickly move the sprayed liquid droplets P. Second, the present invention comprises an voltage applying means wherein the high voltage is applied to the capillary and the low voltage having the same polarity as the high voltage applied to the capillary is applied to the guide duct.. Accordingly, the highly charged liquid droplets P continue to move along a central axis of the guide duct toward a portion to which a lower voltage is applied without adhering to the wall of the guide duct as mentioned in the specification. Third, the present invention has a heating means for heating the outer surface of the guide duct so as to the evaporate the sprayed liquid droplets and generate chemical reactions thereof.

Therefore, it is believed that amended Claim 1 is not anticipated by Kaufman et al. or Allen et al., as fully stated above. The remaining Claims 2-7 include all the limitations of the Claim 1 and impose further limitation thereon, and are similarly submitted to be patentable. Also, the amended method Claim 12 and the remaining Claims 13-15 according to the present invention is not anticipated by the device of Kaufman et al. or the device of Allen et al.

In view of the foregoing amendments and remarks, this application is now deemed to be in condition for allowance. An early action to that affect is courteously solicited.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 07-1337 and please credit any excess fees to such deposit account.

Respectfully submitted,

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